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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 09/865,546 | 05/29/2001 | Taiji Noda | 740819-560 | 4022 |

22204 7590 07/09/2003

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EXAMINER

SARKAR, ASOK K

ART UNIT

PAPER NUMBER

2829

DATE MAILED: 07/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .

09/865,546

Applicant(s)

NODA, TAIJI

Examiner

Asok K. Sarkar

Art Unit

2829

-- The MAILING DATE of this c mmunicati n appears n th c ver sheet with the c rresp nd nce address --

P r i d for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 and 33-38 is/are pending in the application.
- 4a) Of the above claim(s) 10-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9, 28-31 and 33-38 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 May 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on June 5, 2003 has been entered.

Response to Arguments

2. Applicant's arguments with respect to claims 1 – 9, 28 – 31 and 33 - 38 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1 – 3, 6, 7, 29, 33, 34 and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by Kobayashi, US 4,969,031.

Kobayashi teaches a semiconductor device comprising an epitaxial semiconductor substrate 41 (see Fig. 5A) having an epitaxial region 43 formed by epitaxially growing Si on a Si substrate (wafer) of 110 orientation (see column 2, lines 46 – 57), a diffusion layer 45 formed in the epitaxial region 43 (see Fig. 5C) using a

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dopant having a relatively large mass number such as In and Sb (see column 8, lines 2 – 8). The silicon substrate is a wafer formed by the Cz method and since the epitaxial region is formed on the wafer with (110) face orientation it will inherently have <110> oriented zone axis. The device according to Fig. 5 has the diffusion layer shallower than the epitaxial region and the substrate has a laminated structure including a silicon substrate and the epitaxial region formed by epitaxial growth of silicon.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 28 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kobayashi, US 4,969,031 in view of Burr, US 6,093,951.

Kobayashi teaches forming the MOSFET type devices forming diffusion layers with In but fails to teach the ion dose for doping.

Burr teaches doping with In at levels of 10^{13} cm^{-2} and over $5 \times 10^{13} \text{ cm}^{-2}$ level with n-type ions such as As and Sb and fails to expressly teach doping with In at dose over $5 \times 10^{13} \text{ cm}^{-2}$ in column 14, lines 42 - 48.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to form the diffusion layer with In instead of Sb since heavy ions such as In and Sb have smaller diffusion coefficient.

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7. Claims 4, 5, 8, 9, 30, 31, 36 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Admitted prior Art (APA) in view of Kobayashi, US 4,969,031 and Burr, US 6,093,951.

The APA teaches a MIS device with a gate electrode above a semiconductor substrate, a source/drain diffusion layer of first conductivity type, an extension zone of heavily doped diffusion layer and a pocket region doped with a second conductivity type dopant under the extension zone of heavily doped diffusion layer.

The APA fails to expressly teach heavy doping ($> 5 \times 10^{13} \text{ cm}^{-2}$) by In, extension zone of heavily doped diffusion layer of Sb ion and epitaxial region with $\langle 110 \rangle$ - oriented zone axis.

Kobayashi teaches epitaxial region with $\langle 110 \rangle$ - oriented zone axis and implanting with heavy ions such as Sb and In as explained above in rejecting claims 2 and 6 in order to form MOSFET devices with high carrier mobility.

Burr teaches a semiconductor device comprising a heavily doped diffusion layer formed (see Fig. 1) by using dopant ion In and Sb of relatively large mass number such as In in column 14, lines 35 – 41 in an epitaxial region of silicon included in at least an upper portion of the epitaxial silicon substrate in column 5, lines 45 – 50 and in column 15, lines 48 – 50.

Burr also teaches a similar device in which the epitaxial layer is formed to form the device elements (source, drain and channel region) with reference to Figs 1 and 2 in column 16, lines 30 – 34.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify the teachings of APA and build the device by growing an epitaxial region with $\langle 110 \rangle$ - oriented zone axis or use a substrate with $\langle 110 \rangle$ - oriented zone axis to grow epitaxial layer as taught by Kobayashi to improve carrier mobility by causing the tensile strain to remain in the active layer and use heavily doped pocket and extension regions with ions such as In and Sb of large mass numbers as taught by Burr so that the size and area of the doped regions can be accurately controlled to enhance device performance.

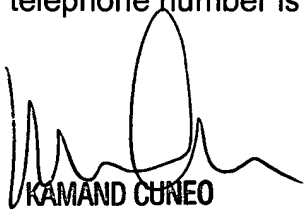
Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 703 308 2521. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kammie Cuneo can be reached on 703 308 1233. The fax phone numbers for the organization where this application or proceeding is assigned are 703 308 7722 for regular communications and 703 308 7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 4918.

Asok K. Sarkar
June 26, 2003



KAMAND CUNEO
SUPERVISORY PATENT EXAMINER
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